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# SCIENCE

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## A. PROGRAM OVERVIEW

### RATIONALE

Children have a natural curiosity about their surroundings—a desire to explore and investigate, see inside things, find out how things work and find answers to their questions. Learning about science provides a framework for students to understand and interpret the world around them.

An elementary science program engages students in a process of inquiry and problem solving in which they develop both knowledge and skills. The purpose of the program is to encourage and stimulate children's learning by nurturing their sense of wonderment, by developing skill and confidence in investigating their surroundings and by building a foundation of experience and understanding upon which later learning can be based.

Elementary and secondary science programs help prepare students for life in a rapidly changing world—a world of expanding knowledge and technology in which new challenges and opportunities continually arise. Tomorrow's citizens will live in a changing environment in which increasingly complex questions and issues will need to be addressed. The decisions and actions of future citizens need to be based on an awareness and understanding of their world and on the ability to ask relevant questions, seek answers, define problems and find solutions.

### PHILOSOPHY

The science program of studies is built on the following principles.

- **Children's curiosity provides a natural starting point for learning.**

Young children are natural inquirers and problem solvers. They have a keen interest in the materials around them and move naturally into activities that involve manipulation of materials, exploration and discovery. Science in the elementary school years should nurture and extend this curiosity, so that students continue to question, explore and investigate, with increasing levels of insight and skill.

- **Children's learning builds on what they currently know and can do.**

Children's initial concepts of the world influence what they observe and how they interpret the events they experience. They enter school having learned a great deal about their world through play and exploration. They show extensive practical knowledge about materials in their environment, as well as the ability to observe, question, test, construct and create. Science experiences in the elementary years are designed to build on the knowledge that students already have and to extend and sharpen their investigative skills.

As children progress in learning, they add to their knowledge and modify their ideas and ways of viewing the world. Where, in the early years, children view their experiences as personal and immediate; in later years, they become aware of order and continuity in the world extending beyond their personal experience. As they grow in this awareness, they discover new patterns in things—patterns of structure, patterns in the order of events and patterns in the way that materials interact. The science program is designed to assist students in discovering and interpreting these patterns and to help them connect new ideas with their existing knowledge.

- **Communication is essential for science learning.**

Language provides a means for students to develop and explore their ideas and to express what they have learned. By communicating their questions, observations, discoveries, predictions and conclusions, they can refine and consolidate their learning and identify new connections and avenues to explore. As children relate their experiences and ideas to one another, they naturally make new connections that are not fully realized until they are put into words.

Language also plays a role in developing the skills of inquiry and problem solving. The actions of identifying problems, asking questions and proposing ideas requires the use of a particular kind of language. The ability to define problems and ask clear questions is a keystone to growth in this area.

- **Students learn best when they are challenged and actively involved.**

Students learn best when they become personally involved in their learning—not just when they mechanically follow a set of steps or read and hear about things learned and done by others. Active inquiry and problem solving can be stimulated by providing an initial focus and challenge for learning, by

engaging students in developing or adapting a plan of action and by involving students in evaluating results. By participating in activities and reflecting on the meaning of what they do, students develop the skills of learning how to learn and achieve depth in their understanding.

- **Confidence and self-reliance are important outcomes of learning.**

Children develop confidence when their ideas and contributions are valued and when there is a supportive climate for learning. By providing opportunities for students to explore ideas and materials, engage in open-ended activities and evaluate their own progress, they can be encouraged to take initiative in learning. When questions and problems are referred back to students and their ideas and decisions are supported, they learn to become more self-reliant. Confidence is achieved as students recognize that the knowledge and skills they have gained enable a measure of independent action.

The personal skills that students develop in school—the ability to make decisions, to plan and to evaluate their own progress—are skills that apply throughout life.

## **PROGRAM EMPHASIS**

Children learn to inquire and solve problems in a variety of contexts. Each subject area within the elementary program provides a rich source of topics for developing questions, problems and issues, that provide starting points for inquiry and problem solving. By engaging in the search for answers, solutions and decisions, students have a purpose for learning and an opportunity to develop concepts and skills within a meaningful context.

The learner expectations for the elementary science program are linked to two main areas of skill emphasis: science inquiry and problem solving through technology. The skills developed

in these two areas are related, but have a somewhat different focus. In science inquiry, the focus is on asking questions and finding answers based on evidence. The outcome of inquiry is knowledge. In problem solving through technology, the focus is on practical tasks—finding ways of making and doing things to meet a given need, using available materials. The outcome of problem solving is a product or process that a person can use.

### **Science Inquiry**

Inquiry is the process of finding answers to questions. The skills of science inquiry include asking questions, proposing ideas, observing, experimenting, and interpreting the evidence that is gathered. Observation and evidence are key elements.

An inquiry may be initiated in a variety of ways. It may be based on a question brought to the classroom by a teacher or student; or it may arise out of an activity, an interesting observation, an unexplained event or a pattern that appears worth pursuing. Engagement in inquiry is not a linear process; it can have a variety of starting points, and the steps followed may vary from one inquiry activity to another. When an unexpected observation is made or a procedure does not work, there is opportunity for new ideas to emerge and a new set of procedures to be followed.

### **Problem Solving through Technology**

Problem solving refers to a variety of processes used to obtain a desired result. The skills of problem solving include identifying what is needed, proposing ways of solving the problem, trying out ideas and evaluating how things work.

In problem solving, as in inquiry, the process is usually not a linear one. Often, processes that will be needed to solve a problem are not foreseen in advance; and there may be repeated cycles of reflection, developing new ideas and trying new approaches, all within the larger pattern of the activity.

Challenging problems require persistence. An idea may not work at first; but with careful observation, adjustment, reflection and refinement, a solution that is close to the original idea may be found. Student success in inquiry and problem solving is enhanced when students have the opportunity to explore materials in an unstructured way, before starting formal investigations. Progress frequently involves trial and error, in which initial ideas are discarded and new ideas and processes are developed. A supportive climate for trying new ideas can be critically important to the development of student confidence and competence in their investigative skills.

## PROGRAM STRUCTURE

The elementary science program has been designed as a series of five topics for each grade. Each topic may be developed as a separate unit of study or linked to other topics and other subject areas.

The order of topics within a grade may be varied as part of the instructional plan. Some topics lend themselves to development throughout the school year; for example, Seasonal Changes. Others may be developed as discrete units. Each grade includes one topic emphasizing problem solving through technology; and, except for Grade 1, there is a corresponding topic emphasizing science inquiry.

Grade	Topic	Emphasis
<b>1</b>	A. Creating Colour B. Seasonal Changes C. Building Things D. Senses E. Needs of Animals and Plants	Science Inquiry Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry
<b>2</b>	A. Exploring Liquids B. Buoyancy and Boats C. Magnetism D. Hot and Cold Temperature E. Small Crawling and Flying Animals	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry
<b>3</b>	A. Rocks and Minerals B. Building with a Variety of Materials C. Testing Materials and Designs D. Hearing and Sound E. Animal Life Cycles	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry
<b>4</b>	A. Waste and Our World B. Wheels and Levers C. Building Devices and Vehicles that Move D. Light and Shadows E. Plant Growth and Changes	Science Inquiry Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry
<b>5</b>	A. Electricity and Magnetism B. Mechanisms Using Electricity C. Classroom Chemistry D. Weather Watch E. Wetland Ecosystems	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry
<b>6</b>	A. Air and Aerodynamics B. Flight C. Sky Science D. Evidence and Investigation E. Trees and Forests	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry

For each grade, a set of skill and attitude expectations is identified. Skill expectations are arranged under three headings: Focus, Explore and Investigate, and Reflect and Interpret. This organization of skill expectations reflects a general pattern of skill use within science

activities, but is not intended as a fixed instructional sequence. As students proceed through their explorations and investigations, there likely will be many points where they reflect on the progress of the activity and set a new focus.

## B. LEARNER EXPECTATIONS

### GRADE 1

#### SKILLS

*These skills apply to the five topics of study identified for Grade 1. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 1, students normally will show independence in exploratory activities but require teacher direction in following a structured approach to investigating questions and problems.*

Science Inquiry	Problem Solving through Technology
<b>General Learner Expectations</b>  <i>Students will:</i>  <b>1–1 Bring focus to investigative activities, based on their own questions and those of others.</b>  <b>1–2 Describe materials and objects that have been observed and manipulated, and identify what was done and found out.</b>	<b>General Learner Expectations</b>  <i>Students will:</i>  <b>1–3 Construct, with guidance, an object that achieves a given purpose, using materials that are provided.</b>  <b>Note:</b> <i>Construction tasks will involve the use of a variety of materials to make models of familiar objects.</i>

<b>Specific Learner Expectations</b>  <i>Students will:</i>  <b>Focus</b> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>predict what they think will happen or what they might find</li> </ul> <b>Explore and Investigate</b> <ul style="list-style-type: none"> <li>manipulate materials and make observations that are relevant to questions asked</li> <li>identify materials used</li> <li>recognize and describe steps followed, based on independent activity, on directed activity and on observing the activity of others</li> </ul> <b>Reflect and Interpret</b> <ul style="list-style-type: none"> <li>describe what was observed, using pictures and oral language</li> <li>identify questions being investigated and identify what was learned about each question</li> <li>identify new questions that arise from what was learned.</li> </ul>	<b>Specific Learner Expectations</b>  <i>Students will:</i>  <b>Focus</b> <ul style="list-style-type: none"> <li>identify the problem or task: What structure do we need to make?</li> </ul> <b>Explore and Investigate</b> <ul style="list-style-type: none"> <li>attempt, with guidance, one or more strategies to complete the task</li> <li>engage in all parts of the task</li> <li>identify materials used</li> <li>recognize and describe steps followed, based on independent activity, on directed activity and on observing the activity of others</li> </ul> <b>Reflect and Interpret</b> <ul style="list-style-type: none"> <li>describe the product of the activity, using pictures and oral language</li> <li>identify processes by which the product was made</li> <li>identify how the product might be used.</li> </ul>
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## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 1.*

### General Learner Expectations

*Students will:*

- 1–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.**

### Specific Learner Expectations

*Students will show growth in acquiring and applying the following traits:*

- curiosity
- confidence in personal ability to explore materials and learn by direct study
- inventiveness
- perseverance: staying with an investigation over a sustained period of time
- appreciation of the value of experience and careful observation
- a willingness to work with others and to consider their ideas
- a sense of responsibility for actions taken
- respect for living things and environments, and commitment for their care.

## UNDERSTANDINGS

### Topic A: Creating Colour

#### Overview

Students explore coloured materials, learning about different colours, how they are created, what happens when they are mixed and how they can be transferred from one material to another. Students learn to distinguish and describe colours and work with a variety of materials to create, modify and apply colours. In the process, students learn that different materials have particular properties and that the properties and interactions of materials have to be taken into account when they are used for a specific purpose.

### General Learner Expectations

*Students will:*

- 1–5 Identify and evaluate methods for creating colour and for applying colours to different materials.**

### Specific Learner Expectations

*Students will:*

1. Identify colours in a variety of natural and manufactured objects.
2. Compare and contrast colours, using terms such as lighter than, darker than, more blue, brighter than.
3. Order a group of coloured objects, based on a given colour criterion.
4. Predict and describe changes in colour that result from the mixing of primary colours and from mixing a primary colour with white or with black.
5. Create a colour that matches a given sample, by mixing the appropriate amounts of two primary colours.
6. Distinguish colours that are transparent from those that are not. Students should recognize that some coloured liquids and gels can be seen through and are thus transparent and that other colours are opaque.
7. Compare the effect of different thicknesses of paint. Students should recognize that a very thin layer of paint, or a paint that has been watered down, may be partly transparent.

8. Compare the adherence of a paint to different surfaces; e.g., different forms of papers, fabrics and plastics.
9. Demonstrate that colour can sometimes be extracted from one material and applied to another; e.g., by extracting a vegetable dye and applying it to a cloth, by dissolving and transferring a water-soluble paint.
10. Demonstrate at least one way to separate sunlight into component colours.

## Topic B: Seasonal Changes

### Overview

Students learn that changes in their environment occur in a regular pattern known as the seasons. They explore weather change, and how the ups and downs of weather affect their own lives. Looking beyond themselves and beyond the immediate weather, students are guided to discover that there are larger patterns of change that affect the life habits of many living things. The interactions among different parts of the environment, and the recurrence of change as part of a cycle, are important science ideas that are introduced in this topic.

### General Learner Expectations

*Students will:*

- 1–6 Describe seasonal changes, and interpret the effects of seasonal changes on living things.**

### Specific Learner Expectations

*Students will:*

1. Describe the regular and predictable cycle of seasonal changes:
  - changes in sunlight
  - changes in weather.
2. Identify and describe examples of plant and animal changes that occur on a seasonal basis:
  - changes in form and appearance
  - changes in location of living things
  - changes in activity; e.g., students should recognize that many living things go into a dormant period during winter and survive

- under a blanket of snow as a seed, egg or hibernating animal
  - production of young on a seasonal basis.
3. Identify human preparations for seasonal change and identify activities that are done on a seasonal basis.
  4. Record observable seasonal changes over a period of time.

## Topic C: Building Things

### Overview

Students learn about materials by using them to construct a variety of objects, including model buildings, toys, boats and vehicles. Students select materials to use and gain experience as they cut and shape, fold, pile materials on top of one another, join parts, and try different techniques to achieve the result that they intend. In the process, they learn to look at objects that are similar to what they are trying to construct and, with guidance, begin to recognize the component parts that make up the whole.

### General Learner Expectations

*Students will:*

- 1–7 Construct objects and models of objects, using a variety of different materials.**
- 1–8 Identify the purpose of different components in a personally constructed object or model, and identify corresponding components in a related object or model.**

### Specific Learner Expectations

*Students will:*

1. Select appropriate materials, such as papers, plastics, woods; and design and build objects, based on the following kinds of construction tasks:
  - construct model buildings; e.g., homes (human, animal, from other cultures), garages, schools
  - construct model objects; e.g., furniture, equipment, boats, vehicles

- construct toys; e.g., pop-ups, figures
  - create wind- and water-related artifacts; e.g., dams, water wheels, boats.
2. Identify component parts of personally constructed objects, and describe the purpose of each part.
  3. Compare two objects that have been constructed for the same purpose, identify parts in one object that correspond to parts in another, and identify similarities and differences between these parts.
  4. Recognize that products are often developed for specific purposes, and identify the overall purpose for each model and artifact constructed.

## Topic D: Senses

### Overview

Students develop an awareness of their own senses and how they are used. They learn that each of their senses provides information about particular aspects of our environment; and that, together, the senses enable us to know things and do things that we would not otherwise be able to do, or at least not as easily. Students learn about the function of their senses, how they are cared for, how they could be damaged and how one's own ability to sense things may differ from those of other people and other living things. Through this topic, students learn to sharpen the use of their senses and describe as accurately as possible the information that their senses provide.

### General Learner Expectations

*Students will:*

- 1–9 Use the senses to make general and specific observations, and communicate observations orally and by producing captioned pictures.**
- 1–10 Describe the role of the human senses and the senses of other living things, in enabling perception and action.**

## Specific Learner Expectations

*Students will:*

1. Identify each of the senses, and explain how we use our senses in interpreting the world.
2. Identify ways that our senses contribute to our safety and quality of life.
3. Apply particular senses to identify and describe objects or materials provided and to describe living things and environments. Students meeting this expectation will be able to describe characteristics, such as colour, shape, size, texture, smell and sound.
4. Recognize the limitations of our senses, and identify situations where our senses can mislead us; e.g., feeling hot or cold, optical illusions, tasting with a plugged nose.
5. Recognize that other living things have senses, and identify ways that various animals use their senses; e.g., sensing danger, finding food, recognizing their own young, recognizing a potential mate.
6. Describe ways that people adapt to limited sensory abilities or to the loss of a particular sense; e.g., colour blindness, inability to see objects at close range.
7. Describe ways to take care of our sensory organs, in particular, our eyes and ears.

## Topic E: Needs of Animals and Plants

### Overview

Students learn about living things and what they need to live and grow. By studying a variety of living things, students become familiar with similarities and differences and develop skills for describing and classifying what they see. As the topic progresses, attention is focused on how living things survive, what they need and how their needs are met. Through the topic, students become aware that groups of living things have some common needs and that different animals and plants meet those needs in different ways. Students also learn about their own responsibility in caring for living things.



## **General Learner Expectations**

*Students will:*

### **1–11 Describe some common living things, and identify needs of those living things.**

## **Specific Learner Expectations**

*Students will:*

1. Observe, describe and compare living things.
2. Contrast living and nonliving things.
3. Identify ways in which living things are valued; e.g., as part of a community of living things; as sources of food, clothing or shelter.
4. Classify some common local plants and animals into groups on the basis of visible characteristics; e.g., adaptations for survival, such as claws, beaks, prickles.
5. Identify examples of plants and animals that are normally under human care (domesticated) and those that are normally independent of human care (wild).
6. Identify the requirements of animals to maintain life; i.e., air, food, water, shelter, space; and recognize that we must provide these for animals in our care.
7. Identify the requirements of plants to maintain life; i.e., air, light, suitable temperature, water, growing medium, space; and recognize that we must provide these for plants in our care.
8. Identify ways that land plants depend on soil.
9. Recognize that some plants and animals must adapt to extreme conditions to meet their basic needs; e.g., arctic and desert plants and animals.
10. Give examples of ways in which animals depend on plants and ways in which plants depend on animals; e.g., particular plants may serve as a source of food and shelter, animals may help spread pollen and seeds.

## GRADE 2

### SKILLS

*These skills apply to the five topics of study identified for Grade 2. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 2, students normally will show independence in exploratory activities but require teacher direction in developing a structured approach to investigating questions and problems.*

Science Inquiry	Problem Solving through Technology
<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>2–1 Investigate, with guidance, the nature of things, demonstrating an understanding of the procedures followed.</b></p> <p><b>2–2 Recognize pattern and order in objects and events studied; and, with guidance, record procedures and observations, using pictures and words; and make predictions and generalizations, based on observations.</b></p>	<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>2–3 Construct, with guidance, an object that achieves a given purpose, using materials that are provided.</b></p> <p><i>Note: Construction tasks will involve building objects that float and are stable in water.</i></p>
<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>identify one or more possible answers to questions asked by themselves and others. Ideas may take the form of predictions and hypotheses</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>manipulate materials and make observations that are relevant to questions asked</li> <li>carry out simple procedures identified by others</li> <li>identify materials used and how they were used</li> <li>use, with guidance, print and other sources of information provided. Sources may include library, classroom, community and computer-based resources</li> </ul> <p><b>Reflect and Interpret</b></p> <ul style="list-style-type: none"> <li>describe what was observed, using captioned pictures and oral language</li> <li>describe and explain results; explanations may reflect an early stage of concept development</li> <li>identify applications of what was learned</li> <li>identify new questions that arise from the investigation.</li> </ul>	<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>identify the purpose of the object to be constructed: What structure do we need to make? What does it need to do?</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>attempt, with guidance, a variety of strategies to complete tasks</li> <li>identify steps followed in constructing the object and in testing it to see if it works</li> <li>engage in all parts of the task and allow others to make their contributions</li> <li>identify materials used and how they were used</li> <li>use, with guidance, print and other sources of information provided. Sources may include library, classroom, community and computer-based resources</li> </ul> <p><b>Reflect and Interpret</b></p> <ul style="list-style-type: none"> <li>communicate results of construction activities, using oral language, captioned pictures and simple graphs (pictographs and bar graphs)</li> <li>describe the product and describe and explain the processes by which it was made</li> <li>identify applications for the product that was made.</li> </ul>

## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 2.*

### General Learner Expectations

*Students will:*

- 2–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.**

### Specific Learner Expectations

*Students will show growth in acquiring and applying the following traits:*

- curiosity
- confidence in personal ability to explore materials and learn by direct study
- inventiveness
- perseverance: staying with an investigation over a sustained period of time
- appreciation of the value of experience and careful observation
- a willingness to work with others and to consider their ideas
- a sense of responsibility for actions taken
- respect for living things and environments, and commitment for their care.

## UNDERSTANDINGS

### Topic A: Exploring Liquids

#### Overview

Students learn about the nature of liquids and the interactions of liquids with other materials. They explore liquids by examining droplets, by watching liquids trickle down slopes, by investigating flow rates and by observing liquid interactions with a variety of materials. They learn that some materials are impervious to liquids, while others are absorbent, and that some liquids mix readily while others do not. They observe that liquid water can be changed to ice or to steam, and back again, if heated and cooled, and that wet materials dry out when left open to the air. Through this topic, students learn that water is our most important liquid, that we use water in many ways, and that water is essential to life.

### General Learner Expectations

*Students will:*

- 2–5 Describe some properties of water and other liquids, and recognize the importance of water to living and nonliving things.**
- 2–6 Describe the interaction of water with different materials, and apply that knowledge to practical problems of drying, liquid absorption and liquid containment.**

### Specific Learner Expectations

*Students will:*

1. Recognize and describe characteristics of liquids:
  - recognize and describe liquid flow
  - describe the shape of drops
  - describe the surface of calm water.
2. Compare water with one or more other liquids, such as cooking oil, glycerine or water mixed with liquid detergent. Comparisons

may be based on characteristics, such as colour, ease of flow, tendency of drops to form a ball shape (bead), interactions with other liquids and interactions with solid materials.

3. Compare the amount of liquid absorbed by different materials; e.g., students should recognize that some forms of paper are very absorbent but other forms of paper are not.
4. Evaluate the suitability of different materials for containing liquids. Students should recognize that materials such as writing paper and unglazed pottery are not waterproof and would not be suitable as containers; but that waxed paper and glazed pottery are waterproof and, thus, could be used in constructing or lining a liquid container.
5. Demonstrate an understanding that liquid water can be changed to other states:
  - recognize that on cooling, liquid water freezes into ice and that on heating, it melts back into liquid water with properties the same as before
  - recognize that on heating, liquid water may be changed into steam or water vapor and that this change can be reversed on cooling
  - identify examples in which water is changed from one form to another.
6. Predict that the water level in open containers will decrease due to evaporation, but the water level in closed containers will not decrease.
7. Predict that a wet surface will dry more quickly when exposed to wind or heating and apply this understanding to practical situations, such as drying of paints, clothes and hair.
8. Recognize that water is a component of many materials and of living things.
9. Recognize human responsibilities for maintaining clean supplies of water, and identify actions that are taken to ensure that water supplies are safe.

## Topic B: Buoyancy and Boats

### Overview

Students explore what sinks and what floats, and what makes an effective watercraft. Through building and testing a variety of floating objects, students learn the importance of selecting appropriate materials and the importance of workmanship in shaping, positioning, fitting and waterproofing their constructions, so they will do the intended job. Along the way, students learn about balance and stability and about different methods that can be used in propelling a watercraft. The concept of density is informally developed in this topic.

### General Learner Expectations

*Students will:*

- 2–7 Construct objects that will float on and move through water, and evaluate various designs for watercraft.**

### Specific Learner Expectations

*Students will:*

1. Describe, classify and order materials on the basis of their buoyancy. Students who have achieved this expectation will distinguish between materials that sink in water and those that float. They will also be aware that some “floaters” sit mostly above water, while others sit mostly below water. The terms buoyancy and density may be introduced but are not required as part of this learning expectation.
2. Alter or add to a floating object so that it will sink, and alter or add to a nonfloating object so that it will float.
3. Assemble materials so they will float, carry a load and be stable in water.
4. Modify a watercraft to increase the load it will carry.
5. Modify a watercraft to increase its stability in water.

6. Evaluate the appropriateness of various materials to the construction of watercraft, in particular:
    - the degree to which the material is waterproof (not porous)
    - the ability to form waterproof joints between parts
    - the stiffness or rigidity of the material
    - the buoyancy of the material.
  7. Develop or adapt methods of construction that are appropriate to the design task.
  8. Adapt the design of a watercraft so it can be propelled through water.
  9. Explain why a given material, design or component is appropriate to the design task.
4. Recognize that magnets have polarity, demonstrate that poles may either repel or attract each other, and state a rule for when poles will repel or attract each other.
  5. Design and produce a device that uses a magnet.
  6. Demonstrate that most materials are transparent to the effects of a magnet. A magnetic field will pass through such materials, whereas other materials interact with a magnet.
  7. Compare and measure the strength of magnets.

## Topic C: Magnetism

### Overview

Students explore the interaction of magnets with a variety of materials found within their own environment. By testing the effects of one magnet on another, they learn that magnets show polarity and that the strength of magnetic effects diminishes with distance. They learn to distinguish materials that are affected by magnets from those that are not and learn how magnets can be used in sorting objects, moving things and holding things together.

### General Learner Expectations

*Students will:*

- 2–8 Describe the interaction of magnets with other magnets and with common materials.**

### Specific Learner Expectations

*Students will:*

1. Identify where magnets are used in the environment and why they are used.
2. Distinguish materials that are attracted by a magnet from those that are not.
3. Recognize that magnets attract materials with iron or steel in them; and given a variety of metallic and nonmetallic objects, predict those that will be attracted by a magnet.

## Topic D: Hot and Cold Temperature

### Overview

Students learn that materials are sometimes changed by heating or cooling and that by observing such changes, they can infer how hot or cold an object is. They learn that thermometers provide a helpful way to measure and describe the hotness or coldness of things—a more reliable way than provided by their own senses. Students observe that temperatures can go up and down, including the temperature of their surroundings and the temperatures of particular objects within it. They also learn about methods that are used to control temperature in buildings and how insulation is used to keep things hot or cold.

### General Learner Expectations

*Students will:*

- 2–9 Recognize the effects of heating and cooling, and identify methods for heating and cooling.**

### Specific Learner Expectations

*Students will:*

1. Describe temperature in relative terms, using expressions, such as hotter than, colder than.
2. Measure temperature in degrees Celsius (°C).
3. Describe how heating and cooling materials can often change them; e.g., melting and freezing, cooking, burning.

4. Identify safe practices for handling hot and cold materials and for avoiding potential dangers from heat sources.
5. Recognize that the human body temperature is relatively constant and that a change in body temperature often signals a change in health.
6. Identify ways in which the temperature in homes and buildings can be adjusted; e.g., by turning a thermostat up or down, by opening or closing windows, by using a space heater in a cold room.
7. Describe, in general terms, how local buildings are heated:
  - identify the energy source or fuel
  - recognize that most buildings are heated by circulating hot air or hot water
  - describe how heat is circulated through the school building and through their own homes.
8. Describe the role of insulation in keeping things hot or cold, and identify places where some form of insulation is used; e.g., clothing, refrigerator, coolers, homes.
9. Identify materials that insulate animals from the cold; e.g., wool, fur and feathers; and identify materials that are used by humans for the same purpose.
10. Design and construct a device to keep something hot or cold.
11. Describe ways in which temperature changes affect us in our daily lives.

## **Topic E: Small Crawling and Flying Animals**

### Overview

Students learn about the structure and life habits of animals by studying small animals that live in their own community. By investigating outdoor spaces in and around the school and their homes, students discover a wide range of animals that find shelter and food within the local area. In studying these animals, they learn about where animals live, what they eat, what they are eaten by and features of the animals that suit them to their particular environment.

## **General Learner Expectations**

*Students will:*

**2–10 Describe the general structure and life habits of small crawling and flying animals; e.g., insects, spiders, worms, slugs; and apply this knowledge to interpret local species that have been observed.**

## **Specific Learner Expectations**

*Students will:*

1. Recognize that there are many different kinds of small crawling and flying animals, and identify a range of examples that are found locally.
2. Compare and contrast small animals that are found in the local environment. These animals should include at least three invertebrates—that is, animals such as insects, spiders, centipedes, slugs, worms.
3. Recognize that small animals, like humans, have homes where they meet their basic needs of air, food, water, shelter and space; and describe any special characteristics that help the animal survive in its home.
4. Identify each animal's role within the food chain. To meet this expectation, students should be able to identify the animals as plant eaters, animal eaters or decomposers and identify other animals that may use them as a food source.
5. Describe the relationships of these animals to other living and nonliving things in their habitat, and to people.
6. Identify and give examples of ways that small animals avoid predators, including camouflage, taking cover in burrows, use of keen senses and flight.
7. Describe conditions for the care of a small animal, and demonstrate responsible care in maintaining the animal for a few days or weeks.
8. Identify ways in which animals are considered helpful or harmful to humans and to the environment.

## GRADE 3

### SKILLS

*These skills apply to the five topics of study identified for Grade 3. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 3, students normally will show independence and the ability to work with others in exploratory activities but will normally require teacher guidance in developing a structured approach to investigating questions and problems. At this level, students should recognize the purpose of at least some of the steps followed in investigating questions and problems.*

Science Inquiry	Problem Solving through Technology
<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>3–1 Investigate the nature of things, demonstrating purposeful action that leads to observations and inferences.</b></p> <p><b>3–2 Identify patterns and order in objects and events studied; and, with guidance, record observations, using pictures, words and charts; and make predictions and generalizations, based on observations.</b></p>	<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>3–3 Investigate a practical problem, and develop a possible solution.</b></p> <p><b>Note:</b> <i>The problem will involve building a rigid or semi-rigid structure, using available materials.</i></p>
<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>identify one or more possible answers to questions by stating predictions or hypotheses</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify, with guidance, procedures to be followed in finding answers to given questions</li> <li>carry out procedures developed by themselves or identified by others</li> <li>identify materials and how they are used</li> <li>work independently or with others to carry out the identified procedures</li> <li>identify, with guidance, sources of information and ideas and, with guidance, access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>	<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>identify the purpose of the object to be constructed: What is to be developed? What is it for?</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>attempt a variety of strategies to complete tasks</li> <li>identify steps followed in completing the task and explain the purpose of each step</li> <li>identify materials and how they are used</li> <li>engage in all parts of the task and support the efforts of others</li> <li>identify, with guidance, sources of information and ideas and, with guidance, access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>

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<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• record observations and measurements, using captioned pictures and charts, with guidance in the construction of charts. Computer resources may be used for record keeping and for display and interpretation of data</li><li>• state an inference, based on observations</li><li>• identify applications of what was learned</li><li>• identify new questions that arise from the investigation.</li></ul>	<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate results of construction activities, using written and oral language and pictures</li><li>• evaluate the product and identify possible improvements</li><li>• identify new applications for the design or method of construction.</li></ul>
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## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 3.*

<b>General Learner Expectations</b>  <i>Students will:</i>  <b>3–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.</b>  <b>Specific Learner Expectations</b>  <i>Students will show growth in acquiring and applying the following traits:</i> <ul style="list-style-type: none"><li>• curiosity</li><li>• confidence in personal ability to explore materials and learn by direct study</li><li>• inventiveness and willingness to consider new ideas</li><li>• perseverance in the search for understandings and for solutions to problems</li><li>• a willingness to base their conclusions and actions on the evidence of their own experiences</li><li>• a willingness to work with others in shared activities and in sharing of experiences</li><li>• appreciation of the benefits gained from shared effort and cooperation</li><li>• a sense of responsibility for personal and group actions</li><li>• respect for living things and environments, and commitment for their care.</li></ul>
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## UNDERSTANDINGS

### Topic A: Rocks and Minerals

#### Overview

Students learn about materials found on Earth's surface—rocks, minerals and soil. By closely examining sample rocks, students discover similarities and differences and explore these,

using simple tests and tools. Students learn that each kind of rock has a set of characteristics and that these characteristics can be used in classifying and identifying rocks. In studies of soil, students discover that the component materials include rock fragments and remains of living things, and that different soils have different compositions. Students learn that the characteristics of rock and soil are important to their use within the community.



## General Learner Expectations

*Students will:*

- 3–5 Demonstrate knowledge of materials that comprise Earth’s crust, and demonstrate skill in classifying these materials.**

## Specific Learner Expectations

*Students will:*

1. Compare samples of various kinds of rock, and identify similarities and differences.
2. Given a description of the properties of a particular rock or mineral, identify a sample rock or mineral that matches those properties. Properties that students should be able to describe and interpret include:
  - colour
  - lustre or “shininess”; e.g., shiny, dull, glassy, metallic, earthy
  - texture; e.g., rough, smooth, uneven
  - hardness, based on scratch tests with available materials
  - presence of carbonates. Note that the presence of carbonates can be tested with vinegar or another mild acid
  - crystal shape for minerals, or overall pattern of rocks.
3. Describe and classify a group of rocks and minerals, based upon the above properties.
4. Recognize that rocks are composed of a variety of materials; and given a course-grained rock and magnifier, describe some of the component materials.
5. Recognize and describe the various components within a sample of soil; e.g., clay, sand, pebbles, decaying plants; and describe differences between two different soil samples.
6. Describe ways in which rocks break down to become soil, and demonstrate one or more of these ways; e.g., by shaking a group of small, soft rocks in a jar of water; by striking rocks together.  
**Note:** Safety goggles should be used.
7. Describe some common uses of rocks and minerals; and identify examples of those uses within the school, home or local community.

## Topic B: Building with a Variety of Materials

### Overview

Students use a variety of tools and simple techniques to build things for specific purposes. Their tasks may require that a bridge be built between two desks, a model lookout tower be constructed, or a water container be made, all from available materials. Through these projects, students learn the value of safety and good workmanship and that different materials and designs can be used to obtain the same result. They learn that working together on a common task is easier when ideas and materials are shared.

## General Learner Expectations

*Students will:*

- 3–6 Use, safely, a variety of tools, techniques and materials in construction activities.**
- 3–7 Construct structures, using a variety of materials and designs, and compare the effectiveness of the various materials and designs for their intended purposes.**

## Specific Learner Expectations

*Students will:*

1. Using a variety of materials and techniques, design, construct and test structures that are intended to:
  - support objects
  - span gaps
  - serve as containers
  - serve as models of particular living things, objects or buildings.
2. Select appropriate materials for use in construction tasks, and explain the choice of materials. Students should demonstrate familiarity with a variety of materials, such as papers, woods, plastics, clay and metals.
3. Select tools that are suitable to particular tasks and materials, and use them safely and effectively.
4. Understand and use a variety of methods to join or fasten materials.

5. Identify the intended purpose and use of structures to be built, and explain how knowing the intended purpose and use helps guide decisions regarding materials and design.
6. Understand that simple designs are often as effective as more complex ones, as well as being easier and cheaper to build, and illustrate this understanding with a practical example.
7. Recognize the importance of good workmanship, and demonstrate growth toward good workmanship.
8. Maintain and store materials and tools safely and properly.
9. Apply skills of listening, speaking and cooperative decision making in working with other students on a construction project.

## **Topic C: Testing Materials and Designs**

### Overview

Students study the materials and designs used in construction tasks. They compare paper, clay, cardboard, styrofoam or other available materials to see which are the strongest—which ones resist bending, crushing or tearing—and which are most easily shaped and joined. They test different shapes and thicknesses to find out what makes a structure strong and stable and to find out how much material is needed. Throughout the topic, students learn that many things are considered when materials and designs are selected and that different tasks may require different materials and designs.

### **General Learner Expectations**

*Students will:*

- 3–8 Evaluate the suitability of different materials and designs for their use in a building task.**

## **Specific Learner Expectations**

*Students will:*

1. Recognize that functional structures must be sufficiently strong and stable and that unstable or weak structures are often unsafe to use.
2. Compare and evaluate the strength and stability of different models or objects constructed.
3. Describe the distinctive properties of some common solids, such as wood, paper or plastic, that make them suitable for use as building materials.
4. Apply procedures to test the strength of construction materials, in particular, different stocks of papers, plastics or wood.
5. Apply procedures to test different designs.
6. Apply procedures to test the strength of different methods of joining.
7. Identify and apply methods for making a structure stronger and more stable; e.g., by adding or joining parts to form triangles.

## **Topic D: Hearing and Sound**

### Overview

Students explore the nature of sound, its sources, its qualities and what it is. They learn that sound is vibration and that changes in vibration can affect the loudness, pitch and quality of sound. They learn about sound travel by studying what things carry sound, what things make it louder or softer, and what happens to sound when it reaches their ears. The sensitivity of human ears and those of other animals is examined, as students learn about the safe use of this valuable sense.

### **General Learner Expectations**

*Students will:*

- 3–9 Describe the nature of sound, and demonstrate methods for producing and controlling sound.**

## Specific Learner Expectations

*Students will:*

1. Identify examples of vibration.
2. Recognize that sound is the result of vibration; and demonstrate that the larger the vibration, the louder the sound.
3. Recognize that there are ways of measuring the loudness of sounds and that loud sounds pose a danger to the ear.
4. Recognize that pitch is the result of differences in the rate of vibration, and predict how a change in the rate of vibration will affect a sound.
5. Demonstrate a variety of ways of producing sounds; e.g., by striking an empty glass, by blowing air into a bottle, by constructing and using a device that involves vibrating strings.
6. Use sound-producing devices that the student has constructed to demonstrate methods for controlling the loudness, pitch and quality of sound produced.
7. Identify examples that show that sound can travel through a variety of materials, including solids, liquids and air, and that sound travels in all directions.
8. Describe how the human ear senses vibrations.
9. Compare the range of hearing in humans to that in other animals; e.g., dogs and bats.
10. Recognize that certain sounds have characteristics that cause them to be interpreted as pleasant or unpleasant, and identify these characteristics.
11. Describe changes in hearing that result from continued exposure to loud noise and from the natural process of aging.
12. Construct and evaluate different kinds of soundproofing and sound-amplifying devices.
13. Explain the role that sound plays in communication.

## Topic E: Animal Life Cycles

### Overview

Students learn about the growth and development of animals and discover that different animals have different life cycles. By observing the life cycle of one small animal from its earliest stage to adulthood, students acquire a reference point for

the study of other animals and come to appreciate the beauty and fragility of life. Students learn that the *egg, larva, pupa* and *adult* stages that are characteristic of many insects represent a different life story from that of the *egg, young, adult* life cycle that is common to most vertebrate animals. In studying these animals, students learn about the changes in needs of the young as they grow and develop and about the changing relationship between these animals and their environment.

## General Learner Expectations

*Students will:*

**3–10 Describe the appearances and life cycles of some common animals, and identify their adaptations to different environments.**

**3–11 Identify requirements for animal care.**

## Specific Learner Expectations

*Students will:*

1. Classify a variety of animals, based on observable characteristics; e.g., limbs, teeth, body covering, overall shape, backbone.
2. Observe and describe the growth and development of at least one living animal, as the animal develops from early to more advanced stages. The animal(s) should be from one or more of the following groups: mammals, birds, fish, reptiles, amphibians, insects. Suggested examples include: gerbils, guppies, mealworms, tadpoles, worms, butterflies/moths. Additional examples from other animal groups might also be included: brine shrimp, isopods, spiders.
3. Predict the next stages in the growth and development of at least one animal from each of the following groups: mammals, birds, fish, reptiles, amphibians, insects; and identify similarities and differences in their developmental sequences.
4. Identify the food needs of at least one animal from each of the following groups: mammals, birds, fish, reptiles, amphibians, insects; and describe changes in how each

animal obtains food through different stages of its life.

5. Demonstrate awareness that parental care is characteristic of some animals and not of others, and identify examples of different forms of parental care.
6. Demonstrate awareness that animals require different habitats in order to meet their basic needs of food, water, shelter and space.
7. Recognize adaptations of a young animal to its environment, and identify changes in its relationship to its environment as it goes through life; e.g., tadpoles are adapted for life in an aquatic environment; adult frogs show adaptations to both terrestrial and aquatic environments.
8. Identify examples of environmental conditions that may threaten animal survival, and identify examples of extinct animals.
9. Recognize that habitat preservation can help maintain animal populations, and identify ways that student actions can assist habitat preservation.
10. Demonstrate knowledge of the needs of animals studied, and demonstrate skills for their care.

## GRADE 4

### SKILLS

*These skills apply to the five topics of study identified for Grade 4. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 4, students normally will show independence and the ability to work with others in exploratory activities and, with guidance, a beginning level of independence in investigating questions and problems. At this level, students should be able to recognize the purpose of most steps followed in investigating questions and problems.*

Science Inquiry	Problem Solving through Technology
<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>4-1 Investigate the nature of things, demonstrating purposeful action that leads to inferences supported by observations.</b></p> <p><b>4-2 Identify patterns and order in objects and events studied; and record observations, using pictures, words and charts, with guidance in the construction of charts; and make predictions and generalizations, based on observations.</b></p>	<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>4-3 Investigate a practical problem, and develop a possible solution.</b></p> <p><b>Note:</b> <i>The problem will involve building a structure with moving parts, using available materials.</i></p>

<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>identify one or more possible answers to questions by stating a prediction or a hypothesis</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify, with guidance, ways of finding answers to given questions</li> <li>carry out, with guidance, procedures that comprise a fair test</li> <li>identify materials and how they are used</li> <li>work independently or with others to carry out the identified procedures</li> <li>identify, with guidance, sources of information and ideas and access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>	<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>identify the purpose of problem-solving and construction activities: What problem do we need to solve? What needs must be met?</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify steps followed in completing the task and in testing the product</li> <li>identify materials and how they are used</li> <li>attempt a variety of strategies and modify procedures, as needed (troubleshoot problems)</li> <li>engage in all parts of the task and support the efforts of others</li> <li>identify, with guidance, sources of information and ideas and access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>
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<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate with group members, showing ability to contribute and receive ideas</li><li>• record observations and measurements accurately, using captioned pictures and charts, with guidance in the construction of charts. Computer resources may be used for record keeping and for display and interpretation of data</li><li>• state an inference, based on observations</li><li>• identify possible applications of what was learned</li><li>• identify new questions that arise from what was learned.</li></ul>	<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate with group members, showing ability to contribute and receive ideas</li><li>• evaluate a product, based on a given set of questions or criteria. The criteria/questions may be provided by the teacher or developed by the students. Example criteria include:<ul style="list-style-type: none"><li>– effectiveness—Does it work?</li><li>– reliability—Does it work every time?</li><li>– durability—Does it stand up to repeated use?</li><li>– effort—Is it easy to construct? Is it easy to use?</li><li>– safety—Are there any risks of hurting oneself in making it or using it?</li><li>– use of materials—Can it be made cheaply with available materials? Does it use recycled materials, and can the materials be used again?</li></ul></li><li>• identify possible improvements to the product</li><li>• identify new applications for the design or method of construction.</li></ul>
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## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 4.*

<b>General Learner Expectations</b> <p><i>Students will:</i></p> <p><b>4–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.</b></p> <b>Specific Learner Expectations</b> <p><i>Students will show growth in acquiring and applying the following traits:</i></p> <ul style="list-style-type: none"><li>• curiosity</li><li>• confidence in personal ability to explore materials and learn by direct study</li><li>• inventiveness and willingness to consider new ideas</li><li>• perseverance in the search for understandings and for solutions to problems</li><li>• a willingness to base their conclusions and actions on the evidence of their own experiences</li><li>• a willingness to work with others in shared activities and in sharing of experiences</li><li>• appreciation of the benefits gained from shared effort and cooperation</li><li>• a sense of responsibility for personal and group actions</li><li>• respect for living things and environments, and commitment for their care.</li></ul>
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## UNDERSTANDINGS

### Topic A: Waste and Our World

#### Overview

Students learn about wastes produced through natural processes and human technology. In studying natural systems, students learn that all plants, animals and other living things are made up of materials that are recycled through the environment again and again. In studying human consumption and wastes, students identify wastes produced within their community and learn the methods used for disposal. They learn that some waste materials are biodegradable, that some are reusable, and that others are toxic. They learn that personal action in reducing, reusing and recycling materials can help decrease the waste we accumulate.

#### **General Learner Expectations**

*Students will:*

- 4–5 Recognize that human activity can lead to the production of wastes, and identify alternatives for the responsible use and disposal of materials.**

#### **Specific Learner Expectations**

*Students will:*

1. Identify plant and animal wastes, and describe how they are recycled in nature. For example, plant leaves serve as a source of food for soil insects, worms and other creatures. The wastes of these animals may then be further broken down by molds, fungi and bacteria.
2. Identify and classify wastes that result from human activity.
3. Describe alternative methods of disposal, and identify possible advantages and disadvantages of each.
4. Distinguish between wastes that are readily biodegradable and those that are not.
5. Compare different kinds of packaging, and infer the relative advantages and disadvantages of that packaging. In

evaluating different forms of packaging, students should demonstrate the ability to consider a consumer perspective as well as an environmental perspective.

6. Identify methods of waste disposal currently used within the local community.
7. Identify kinds of wastes that may be toxic to people and to the environment.
8. Identify alternative materials and processes that may decrease the amount of waste produced; e.g., reducing wastage of food, using both sides of a sheet of paper.
9. Identify ways in which materials can be reused or recycled, including examples of things that the student has done.
10. Develop a flow chart for a consumer product that indicates the source materials, final product, its use and method of disposal.
11. Identify actions that individuals and groups can take to minimize the production of wastes, to recycle or reuse wastes and to ensure the safe handling and disposal of wastes.
12. Develop and implement a plan to reduce waste, and monitor what happens over a period of time.

### Topic B: Wheels and Levers

#### Overview

Students learn about basic components of simple machines: how they are assembled, how they operate, how they are used. Students explore different techniques that can be used to transfer motion from one component to another, using simple connectors and various levers, gears, pulleys and band driven systems. As they work with these components, they learn the functions that each can perform, including sample applications and ways that they can be used in a larger system. As part of their studies, they examine how these simple machines are used to change the speed or force of movement.

## General Learner Expectations

*Students will:*

- 4–6 Demonstrate a practical understanding of wheels, gears and levers by constructing devices in which energy is transferred to produce motion.**

## Specific Learner Expectations

*Students will:*

1. Explain how rollers can be used to move an object, and demonstrate the use of rollers in a practical situation.
2. Compare the wheel and the roller, and identify examples where each are used.
3. Construct devices that use wheels and axles, and demonstrate and describe their use in:
  - model vehicles
  - pulley systems
  - gear systems.
4. Construct and explain the operation of a drive system that uses one or more of the following:
  - wheel-to-wheel contact
  - a belt or elastic
  - a chain
  - cogs or gears.
5. Construct and explain the operation of a drive system that transfers motion from one shaft to a second shaft, where the second shaft is:
  - parallel to the first
  - at a 90° angle to the first.

Students who have achieved this expectation will be aware of changes in speed and direction that result from different ways of linking components. Introduction of gear ratios, however, is not recommended at this grade level. Students will have an opportunity to develop the concept of ratio as part of their junior high mathematics program.
6. Demonstrate ways to use a lever that:
  - applies a small force to create a large force
  - applies a small movement to create a large movement.
7. Predict how changes in the size of a lever or the position of the fulcrum will affect the forces and movements involved.
8. Construct models of levers; and explain how levers are involved in such devices as: teeter-totters, scissors, pliers, pry bars, tongs, nutcrackers, fishing rods, wheelbarrows.

## Topic C: Building Devices and Vehicles that Move

### Overview

Students apply simple techniques and tools in building devices and vehicles that move. In constructing these objects, students apply previous learnings about structures and explore new applications for wheels, rollers, gears, pulleys and a variety of levers and connectors. They learn that different forms of energy can be used to propel their model devices: in some cases, a direct push; in other cases, the stored energy from a compressed spring or falling weight. On completing their projects, students learn to evaluate their work, by describing the effectiveness of the device and the appropriateness of materials used.

## General Learner Expectations

*Students will:*

- 4–7 Construct a mechanical device for a designated purpose, using materials and design suggestions provided.**

**Note:** One or more components of the task will be open-ended and require students to determine the specific procedure to be followed.

- 4–8 Explore and evaluate variations to the design of a mechanical device, demonstrating that control is an important element in the design and construction of that device.**

## Specific Learner Expectations

*Students will:*

1. Design and construct devices and vehicles that move or have moving parts—linkages, wheels and axles.
2. Use simple forces to power or propel a device; e.g., direct pushes, pulls, cranking mechanisms, moving air, moving water and downhill motion.



3. Design and construct devices and vehicles that employ energy-storing or energy-consuming components that will cause motion; e.g., elastic bands, springs, gravity, wind, moving water.
4. Recognize the need for control in mechanical devices, and apply control mechanisms where necessary.
5. Compare two designs, identifying the relative strengths and weaknesses of each.
6. Identify steps to be used in constructing a device or vehicle, and work cooperatively with other students to construct the device or vehicle.
7. Design and construct several different models of a device and evaluate each model, working cooperatively with other students. Suggested evaluation criteria are identified under the Specific Learner Expectations, Reflect and Interpret, page B.18.

## Topic D: Light and Shadows

### Overview

Students learn about light by studying the effects of light on things within their environment. They learn about light sources, about materials that light can pass through and about what happens when a material blocks or changes the path of light. By observing shadows and their motions relative to a light source, students discover that light and shadows fall along a predictable path. They discover that mirrors, prisms and a variety of other materials can affect that path by reflecting and refracting light and by splitting light into colours.

### General Learner Expectations

*Students will:*

- 4–9 Identify sources of light, describe the interaction of light with different materials, and infer the pathway of a light beam.**

### Specific Learner Expectations

*Students will:*

1. Recognize that eyes can be damaged by bright lights and that one should not look at the Sun—either directly or with binoculars or telescopes.
2. Identify a wide range of sources of light, including the Sun, various forms of electric lights, flames, and materials that glow (luminescent materials).
3. Distinguish objects that emit their own light from those that require an external source of light in order to be seen.
4. Demonstrate that light travels outward from a source and continues unless blocked by an opaque material.
5. Describe changes in the size and location of Sun shadows during the day—early morning, to midday, to late afternoon.
6. Recognize that opaque materials cast shadows, and predict changes in the size and location of shadows resulting from the movement of a light source or from the movement of a shade-casting object.
7. Distinguish transparent materials from opaque materials by determining if light passes through them and by examining their shadows.
8. Classify materials as transparent, partly transparent (translucent) or opaque.
9. Recognize that light can be reflected and that shiny surfaces, such as polished metals and mirrors, are good reflectors.
10. Recognize that light can be bent (refracted) and that such objects as aquaria, prisms and lenses can be used to show that light beams can be bent.
11. Recognize that light can be broken into colours and that different colours of light can be combined to form a new colour.
12. Demonstrate the ability to use a variety of optical devices, describe how they are used, and describe their general structure. Suggested examples include: hand lens, telescope, microscope, pinhole camera, light-sensitive paper, camera, kaleidoscope. Students meeting this expectation will be able to provide practical descriptions of the operation of such devices, but are not required to provide theoretical explanations of how the devices work.

## Topic E: Plant Growth and Changes

### Overview

Students learn about the structure and growth of plants by raising plants in the classroom and by observing plant growth within the community. They learn to recognize and describe different forms of leaves, stems, roots and flowers and learn their functions in supporting the growth and reproduction of the plant. They learn various ways of starting new plants and the plants' requirements for growth. Through hands-on activities, students learn that different plants have different needs, and they gain skills and attitudes for their care.

### General Learner Expectations

*Students will:*

#### **4–10 Demonstrate knowledge and skills for the study, interpretation, propagation and enhancement of plant growth.**

### Specific Learner Expectations

*Students will:*

1. Describe the importance of plants to humans and their importance to the natural environment. Students who meet this expectation should be able to give examples of plants being used as a source of food or shelter, and be aware of the role plants play in the environment; e.g., preventing erosion, maintaining oxygen.
2. Identify and describe the general purpose of plant roots, stems, leaves and flowers.
3. Describe common plants, and classify them on the basis of their characteristics and uses.
4. Recognize that plant requirements for growth; i.e., air, light energy, water, nutrients and space; vary from plant to plant and that other conditions; e.g., temperature and humidity; may also be important to the growth of particular plants.
5. Identify examples of plants that have special needs.

6. Recognize that a variety of plant communities can be found within the local area and that differences in plant communities are related to variations in the amount of light, water and other conditions.
7. Recognize that plants of the same kind have a common life cycle and produce new plants that are similar, but not identical, to the parent plants.
8. Describe ways that various flowering plants can be propagated, including from seed, from cuttings, from bulbs and by runners.
9. Nurture a plant through one complete life cycle—from seed to seed.
10. Describe the care and growth of a plant that students have nurtured, in particular:
  - identify the light, temperature, water and growing medium requirements of the plant
  - identify the life stages of the plant
  - identify the reproductive structures of the plant.
11. Describe different ways that seeds are distributed; e.g., by wind, by animals; and recognize seed adaptations for different methods of distribution.

## GRADE 5

### SKILLS

*These skills apply to the five topics of study identified for Grade 5. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 5, students normally will show independence and the ability to work cooperatively in exploratory activities and, with some guidance, the ability to work independently or cooperatively in investigative activities. At this level, students should be able to describe the purpose of most steps followed in investigative activities.*

Science Inquiry	Problem Solving through Technology
<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>5–1 Design and carry out an investigation, using procedures that provide a fair test of the question being investigated.</b></p> <p><b>5–2 Recognize the importance of accuracy in observation and measurement; and, with guidance, apply suitable methods to record, compile, interpret and evaluate observations and measurements.</b></p>	<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>5–3 Design and carry out an investigation of a practical problem, and develop a possible solution.</b></p> <p><i>Note: The problem will involve construction of a mechanical device with electrical components.</i></p>
<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>identify one or more possible answers to questions by stating a prediction or a hypothesis</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify one or more ways of finding answers to given questions</li> <li>plan, with guidance, and carry out procedures that comprise a fair test</li> <li>identify variables that need to be held constant to ensure a fair test</li> <li>select appropriate materials and identify how they will be used</li> <li>work individually or cooperatively in planning and carrying out procedures</li> <li>identify sources of information and ideas and access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>	<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>identify problems to be solved and the purpose(s) of the problem-solving activity: What problem(s) are we trying to solve? What conditions must be met? What controls are required? How will we know that we have done what we set out to do?</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify one or more possible approaches to solving the problem and plan, with guidance, a set of steps to follow</li> <li>select appropriate materials and identify how they will be used</li> <li>attempt a variety of strategies and modify procedures, as needed (troubleshoot problems)</li> <li>work individually or cooperatively in planning and carrying out procedures</li> <li>identify sources of information and ideas and access information and ideas from those sources. Sources may include library, classroom, community and computer-based resources</li> </ul>

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<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate with group members to share and evaluate ideas, and assess progress</li><li>• record observations and measurements accurately, using a chart format where appropriate. Computer resources may be used for record keeping and for display and interpretation of data</li><li>• state an inference, based on results. The inference will identify a cause and effect relationship that is supported by observations</li><li>• evaluate how well the procedures worked and identify possible improvements</li><li>• identify possible applications of what was learned</li><li>• identify new questions that arise from what was learned.</li></ul>	<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate with group members to share and evaluate ideas, and assess progress</li><li>• evaluate the procedures used to solve the problem and identify possible improvements</li><li>• evaluate a design or product, based on a given set of questions or criteria. The criteria/questions may be provided by the teacher or developed by the students. Example criteria include:<ul style="list-style-type: none"><li>– effectiveness—Does it work?</li><li>– reliability—Does it work every time?</li><li>– durability—Does it stand up to repeated use?</li><li>– effort—Is it easy to construct? Is it easy to use?</li><li>– safety—Are there any risks of hurting oneself in making it or using it?</li><li>– use of materials—Can it be made cheaply with available materials? Does it use recycled materials, and can the materials be used again?</li><li>– effect on environments</li><li>– benefit to society</li></ul></li><li>• identify new applications for the design or problem solution.</li></ul>
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## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 5.*

<b>General Learner Expectations</b> <p><i>Students will:</i></p> <p><b>5–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.</b></p> <b>Specific Learner Expectations</b> <p><i>Students will show growth in acquiring and applying the following traits:</i></p> <ul style="list-style-type: none"><li>• curiosity</li><li>• confidence in personal ability to learn and develop problem-solving skills</li><li>• inventiveness and open-mindedness</li><li>• perseverance in the search for understandings and for solutions to problems</li><li>• flexibility in considering new ideas</li><li>• critical-mindedness in examining evidence and determining what the evidence means</li><li>• a willingness to use evidence as the basis for their conclusions and actions</li><li>• a willingness to work with others in shared activities and in sharing of experiences</li><li>• appreciation of the benefits gained from shared effort and cooperation</li><li>• a sense of personal and shared responsibility for actions taken</li><li>• respect for living things and environments, and commitment for their care.</li></ul>
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## UNDERSTANDINGS

### Topic A: Electricity and Magnetism

#### Overview

Students learn about electricity by building and testing circuits. Using batteries, bulbs and wires, students construct simple circuits and test the effects of various modifications. Through such tests, they discover that a circuit requires a closed pathway for electricity and that some materials conduct electricity and others do not. They learn that an electric current can affect a nearby magnet and that this property of electricity is used in making electromagnets and motors. Potential dangers are examined, as students learn about the safe use of electricity.

#### General Learner Expectations

*Students will:*

**5–5 Demonstrate safe methods for the study of magnetism and electricity, identify methods for measurement and control, and apply techniques for evaluating magnetic and electrical properties of materials.**

#### Specific Learner Expectations

*Students will:*

1. Recognize and appreciate the potential dangers involved in using sources of electrical currents:
  - understand that household electrical currents are potentially dangerous and not a suitable source for experimentation
  - understand that small batteries are a relatively safe source of electricity, for experimentation and study, but that care should be taken to avoid short circuits
  - understand that short circuits may cause wires to heat up, as well as waste the limited amount of energy in batteries.
2. Describe and demonstrate example activities that show that electricity and magnetism are related:
  - demonstrate that electricity can be used to create magnetism
  - demonstrate that a moving magnet can be used to generate electricity.

3. Demonstrate and interpret evidence of magnetic fields around magnets and around current-carrying wires, by use of iron filings or by use of one or more compasses.
4. Demonstrate that a continuous loop of conducting material is needed for an uninterrupted flow of current in a circuit.
5. Distinguish electrical conductors—materials that allow electricity to flow through them—from insulators—materials that do not allow electricity to flow through them.
6. Recognize and demonstrate that some materials, including resistors, are partial conductors of electricity.
7. Predict the effect of placing an electrical resistance in a simple circuit; e.g., in a circuit with a light bulb or electric motor.
8. Recognize that the amount of electricity we use in our homes is measured in kilowatt hours.
9. Interpret and explain:
  - the reading on a household electrical meter
  - efficiency labels on electrical appliances.
10. Draw and interpret, with guidance, circuit diagrams that include symbols for switches, power sources, resistors, lights and motors.

### Topic B: Mechanisms Using Electricity

#### Overview

Students build electrical devices for a variety of purposes, using knowledge gained in the previous topic. Tasks that students are assigned may include such things as making a switch from scrap materials, making a device to control the speed of a motor, making a burglar alarm and lighting three bulbs from one source. Through work on these tasks, students learn the role of various components and control devices that are part of an electrical system. At the same time, they develop skills of problem solving and teamwork.

## General Learner Expectations

*Students will:*

- 5–6 Construct simple circuits, and apply an understanding of circuits to the construction and control of motorized devices.**

## Specific Learner Expectations

*Students will:*

1. Identify example applications of electrical devices in the school and home environment, and classify the kinds of uses. Categories of electrical use may include such things as: heating, lighting, communicating, moving, computing.
2. Design and construct circuits that operate lights and other electrical devices.
3. Recognize the importance of switches and other control mechanisms to the design and operation of electrical devices, and identify purposes of switches in particular applications.
4. Construct and use a variety of switches.
5. Design and construct vehicles or other devices that use a battery-powered electric motor to produce motion; e.g., model cars, hoists, fans.
6. Design and construct a burglar alarm.
7. Demonstrate different ways of lighting two lights from a single power source, and compare the results. Students should recognize that wiring two bulbs in series makes both bulbs glow less brightly than if the bulbs are wired in parallel. Students may demonstrate this knowledge operationally and do not need to use the terms series and parallel.
8. Demonstrate different ways of using two batteries to light a bulb, and compare the results. Students should recognize that wiring the batteries in series causes the bulb to glow brighter than it would if parallel wiring were used.
9. Given a design task and appropriate materials, invent and construct an electrical device that meets the task requirements.

## Topic C: Classroom Chemistry

### Overview

Students learn about the properties and interactions of some safe to handle household liquids and solids. They test a variety of materials to see what happens when things are mixed together: what dissolves, what reacts and what remains unaffected. They discover that when a solid material dissolves, it can be recovered as a crystal by evaporating the liquid. They also learn that when two materials react to form a new material, the original materials cannot be recovered. As an example of a chemical reaction, students learn to produce carbon dioxide gas and show that this gas differs from ordinary air.

## General Learner Expectations

*Students will:*

- 5–7 Describe the properties and interactions of various household liquids and solids, and interpret their interactions.**

## Specific Learner Expectations

*Students will:*

1. Recognize and identify examples of the following kinds of mixtures:
  - two or more solids; e.g., sand and sugar
  - a solid and a liquid; e.g., sugar and water
  - two or more liquids; e.g., milk and tea.
2. Apply and evaluate a variety of techniques for separating different materials.
3. Distinguish substances that will dissolve in a liquid from those that will not, and demonstrate a way of recovering a material from solution.
4. Demonstrate a procedure for making a crystal.
5. Recognize that the surface of water has distinctive properties, and describe the interaction of water with other liquids and solids.
6. Produce carbon dioxide gas through the interaction of solids and liquids, and demonstrate that it is different from air.
7. Distinguish reversible from irreversible changes of materials, and give examples of each.

8. Recognize and describe evidence of a chemical reaction. Explain how the products of a reaction differ from the original substances.
9. Use an indicator to identify a solution as being acidic or basic.

## Topic D: Weather Watch

### Overview

Students learn about weather phenomena and the methods used for weather study. They learn to measure temperatures, wind speed and direction, the amounts of rain and snow, and the amount of cloud cover. In studying causes and patterns of air movements, students learn about the effects of uneven heating and cooling and discover the same patterns of air movement in indoor environments as are found outdoors. They also learn about human actions that can affect weather and climate and study the design and testing of clothing used as protection against the weather.

### General Learner Expectations

*Students will:*

**5–8 Observe, describe and interpret weather phenomena; and relate weather to the heating and cooling of Earth’s surface.**

**5–9 Investigate relationships between weather phenomena and human activity.**

### Specific Learner Expectations

*Students will:*

1. Predict where, within a given indoor or outdoor environment, one is likely to find the warmest and coolest temperatures.
2. Describe patterns of air movement, in indoor and outdoor environments, that result when one area is warm and another area is cool.
3. Describe and demonstrate methods for measuring wind speed and for finding wind direction.
4. Describe evidence that air contains moisture and that dew and other forms of precipitation come from moisture in the air.

5. Describe and measure different forms of precipitation, in particular, rain, hail, sleet, snow.
6. Measure at least four different kinds of weather phenomena. Either student-constructed or standard instruments may be used.
7. Record weather over a period of time.
8. Identify some common types of clouds, and relate them to weather patterns.
9. Describe the effects of the Sun’s energy on daily and seasonal changes in temperature—24-hour and yearly cycles of change.
10. Recognize that weather systems are generated because different surfaces on the face of Earth retain and release heat at different rates.
11. Understand that climate refers to long term weather trends in a particular region and that climate varies throughout the world.
12. Recognize that human actions can affect climate, and identify human actions that have been linked to the greenhouse effect.
13. Appreciate how important it is to be able to forecast weather and to have suitable clothing or shelter to endure various types of weather.
14. Test fabrics and clothing designs to choose those with characteristics that most effectively meet the challenges of particular weather conditions; e.g., water resistance, wind resistance, protection from cold.

## Topic E: Wetland Ecosystems

### Overview

Students learn about wetland ecosystems by studying life in a local pond, slough, marsh, fen or bog. Through classroom studies, and studies in the field, students learn about organisms that live in, on and around wetlands and about adaptations that suit pond organisms to their environment. Through observation and research, students learn about the interactions among wetland organisms and about the role of each organism as part of a food web. The role of human action in affecting wetland habitats and populations is also studied.

## General Learner Expectations

*Students will:*

### **5–10 Describe the living and nonliving components of a wetland ecosystem and the interactions within and among them.**

11. Recognize that changes in part of an environment have effects on the whole environment.

## Specific Learner Expectations

*Students will:*

1. Recognize and describe one or more examples of wetland ecosystems found in the local area; e.g., pond, slough, marsh, bog, fen.
2. Understand that a wetland ecosystem involves interactions between living and nonliving things, both in and around the water.
3. Identify some plants and animals found at a wetland site, both in and around the water; and describe the life cycles of these plants and animals.
4. Identify and describe adaptations that make certain plants and animals suited for life in a wetland.
5. Understand and appreciate that all animals and plants, not just the large ones, have an important role in a wetland community.
6. Identify the roles of different organisms in the food web of a pond:
  - producers—green plants that make their own food, using sunlight
  - consumers—animals that eat living plants and/or animals
  - decomposers—organisms, such as molds, fungi, insects and worms, that reuse and recycle materials that were formerly living.
7. Draw diagrams of food chains and food webs, and interpret such diagrams.
8. Recognize that some aquatic animals use oxygen from air and others from water, and identify examples and adaptations of each.
9. Identify human actions that can threaten the abundance or survival of living things in wetland ecosystems; e.g., adding pollutants, changing the flow of water, trapping or hunting pond wildlife.
10. Identify individual and group actions that can be taken to preserve and enhance wetland habitats.



## GRADE 6

### SKILLS

*These skills apply to the five topics of study identified for Grade 6. The organization of these skills reflects a general pattern of science activity, not a fixed instructional sequence. At Grade 6, students normally will show independence and the ability to work cooperatively in exploratory and investigative activities. Limited guidance may be required in defining problems and selecting appropriate variables. At this level, students should be able to describe the purpose of each step followed in investigative activities.*

Science Inquiry	Problem Solving through Technology
<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>6-1 Design and carry out an investigation in which variables are identified and controlled, and that provides a fair test of the question being investigated.</b></p> <p><b>6-2 Recognize the importance of accuracy in observation and measurement; and apply suitable methods to record, compile, interpret and evaluate observations and measurements.</b></p>	<p><b>General Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>6-3 Design and carry out an investigation of a practical problem, and develop a possible solution.</b></p> <p><b>Note:</b> <i>The problem will involve construction or modification of a device that moves through air.</i></p>
<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>ask questions that lead to exploration and investigation</li> <li>identify one or more possible answers to questions by stating a prediction or a hypothesis</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify one or more ways of finding answers to given questions</li> <li>plan and carry out procedures that comprise a fair test</li> <li>identify variables: <ul style="list-style-type: none"> <li>identify the variable to be manipulated</li> <li>identify variables to be held constant</li> <li>identify the variable that will be observed (responding variable)</li> </ul> </li> <li>select appropriate materials and identify how they will be used</li> <li>modify the procedures as needed</li> <li>work individually or cooperatively in planning and carrying out procedures</li> <li>identify sources of information and ideas and demonstrate skill in accessing them. Sources may include library, classroom, community and computer-based resources</li> </ul>	<p><b>Specific Learner Expectations</b></p> <p><i>Students will:</i></p> <p><b>Focus</b></p> <ul style="list-style-type: none"> <li>identify problems to be solved and the purpose(s) of problem-solving activities: What problem(s) are we trying to solve? What resources can we use? How will we know that we have done what we set out to do? What possible impacts do we need to consider?</li> </ul> <p><b>Explore and Investigate</b></p> <ul style="list-style-type: none"> <li>identify one or more possible approaches and plan a set of steps for solving the problem</li> <li>select appropriate materials and identify how they will be used</li> <li>attempt a variety of strategies and modify procedures, as needed (troubleshoot problems)</li> <li>work individually or cooperatively in planning and carrying out procedures</li> <li>identify sources of information and ideas and demonstrate skill in accessing them. Sources may include library, classroom, community and computer-based resources</li> </ul>

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<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate effectively with group members in sharing and evaluating ideas, and assessing progress</li><li>• record observations and measurements accurately, using a chart format where appropriate. Computer resources may be used for record keeping and for display and interpretation of data</li><li>• evaluate procedures used and identify possible improvements</li><li>• state an inference, based on results. The inference will identify a cause and effect relationship that is supported by observations</li><li>• identify possible applications of what was learned</li><li>• identify new questions that arise from what was learned.</li></ul>	<b>Reflect and Interpret</b> <ul style="list-style-type: none"><li>• communicate effectively with group members in sharing and evaluating ideas, and assessing progress</li><li>• evaluate procedures used and identify possible improvements</li><li>• evaluate a design or product, based on a given set of questions or criteria. The criteria/questions may be provided by the teacher or developed by the students. Example criteria include:<ul style="list-style-type: none"><li>– effectiveness—Does it work?</li><li>– reliability—Does it work every time?</li><li>– durability—Does it stand up to repeated use?</li><li>– effort—Is it easy to construct? Is it easy to use?</li><li>– safety—Are there any risks of hurting oneself in making it or using it?</li><li>– use of materials—Can it be made cheaply with available materials? Does it use recycled materials, and can the materials be used again?</li><li>– effect on environments</li><li>– benefit to society</li></ul></li><li>• identify positive and negative impacts that may arise and potential risks that need to be monitored: What good effects and what bad effects could this solution have? What would we need to look for to be sure that it is working as intended?</li><li>• identify new applications for the design or problem solution.</li></ul>
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## ATTITUDES

*These attitudes apply across the five topics of study identified for Grade 6.*

<b>General Learner Expectations</b> <p><i>Students will:</i></p> <p><b>6–4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.</b></p> <p><b>Specific Learner Expectations</b></p> <p><i>Students will show growth in acquiring and applying the following traits:</i></p> <ul style="list-style-type: none"><li>• curiosity</li><li>• confidence in personal ability to learn and develop problem-solving skills</li><li>• inventiveness and open-mindedness</li><li>• perseverance in the search for understandings and for solutions to problems</li><li>• flexibility in considering new ideas</li><li>• critical-mindedness in examining evidence and determining what the evidence means</li><li>• a willingness to use evidence as the basis for their conclusions and actions</li><li>• a willingness to work with others in shared activities and in sharing of experiences</li><li>• appreciation of the benefits gained from shared effort and cooperation</li><li>• a sense of personal and shared responsibility for actions taken</li><li>• respect for living things and environments, and commitment for their care.</li></ul>
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## UNDERSTANDINGS

### Topic A: Air and Aerodynamics

#### Overview

Students explore the characteristics of air and the interaction between moving air and solids. They learn that air is a compressible fluid, that it is composed of many gases, and that moving air can support solid materials in sustained flight. By studying birds and airplanes, they learn a variety of adaptations and designs that make flight possible and that provide for propulsion and control.

#### General Learner Expectations

*Students will:*

#### **6–5 Describe properties of air and the interactions of air with objects in flight.**

#### Specific Learner Expectations

*Students will:*

1. Provide evidence that air takes up space and exerts pressure, and identify examples of these properties in everyday applications.
2. Provide evidence that air is a fluid and is capable of being compressed, and identify examples of these properties in everyday applications.
3. Describe and demonstrate instances in which air movement across a surface results in lift—Bernoulli’s principle.
4. Recognize that in order for devices or living things to fly, they must have sufficient lift to overcome the downward force of gravity.
5. Identify adaptations that enable birds and insects to fly.
6. Describe the means of propulsion for flying animals and for aircraft.
7. Recognize that streamlining reduces drag, and predict the effects of specific design changes on the drag of a model aircraft or aircraft components.
8. Recognize that air is composed of different gases, and identify evidence for different gases. Example evidence might include: effects on flames, the “using up” of a particular gas by burning or rusting, animal needs for air exchange.

### Topic B: Flight

#### Overview

Students apply their knowledge of aerodynamics to design, build and test a variety of flying devices. In constructing models, students develop a basic design, then build it, test it, and solve the problems that inevitably arise. Through teamwork they learn that planning, communication, cooperation and flexibility are important to the overall result, even though parts of a task can be worked on individually. In the process, students learn about the parts of an aircraft, their role in controlled flight and the differences between aircraft and spacecraft.

#### General Learner Expectations

*Students will:*

#### **6–6 Construct devices that move through air, and identify adaptations for controlling flight.**

#### Specific Learner Expectations

*Students will:*

1. Conduct tests of a model parachute design, and identify design changes to improve the effectiveness of the design.
2. Describe the design of a hot-air balloon and the principles by which its rising and falling are controlled.
3. Conduct tests of glider designs; and modify a design so that a glider will go further, stay up longer or fly in a desired way; e.g., fly in a loop, turn to the right.
4. Recognize the importance of stability and control to aircraft flight; and design, construct and test control surfaces.
5. Apply appropriate vocabulary in referring to control surfaces and major components of an aircraft. This vocabulary should include: wing, fuselage, vertical and horizontal stabilizers, elevators, ailerons, rudder.
6. Construct and test propellers and other devices for propelling a model aircraft.

7. Describe differences in design between aircraft and spacecraft, and identify reasons for the design differences.

**Note:** Model aircraft or rockets may be constructed and used as part of this topic. It is recommended that these models be simple devices of the student's construction, not prefabricated models. Propulsion of rockets by chemical fuels is neither required nor recommended, due to safety considerations.

## Topic C: Sky Science

### Overview

Students learn about objects in the day and night sky. Through direct observation and research, students learn about the motions and characteristics of stars, moons and planets. Using simple materials, such as balls and beads, students create models and diagrams which they use to explore the relative position and motion of objects in space. As a result of these studies, students move from a simple view of land and sky, to one that recognizes Earth as a sphere in motion within a larger universe. With new understanding, students revisit the topics of seasonal cycles, phases of the Moon and the apparent motion of stars.

### General Learner Expectations

*Students will:*

- 6–7 Observe, describe and interpret the movement of objects in the sky; and identify pattern and order in these movements.**

### Specific Learner Expectations

*Students will:*

1. Recognize that the Sun and stars emit the light by which they are seen and that most other bodies in space, including Earth's Moon, planets and their moons, comets, and asteroids, are seen by reflected light.

2. Describe the location and movement of individual stars and groups of stars (constellations) as they move through the night sky.
3. Recognize that the apparent movement of objects in the night sky is regular and predictable, and explain how this apparent movement is related to Earth's rotation.
4. Understand that the Sun should never be viewed directly, nor by use of simple telescopes or filters, and that safe viewing requires appropriate methods and safety precautions.
5. Construct and use a device for plotting the apparent movement of the Sun over the course of a day; e.g., construct and use a sundial or shadow stick.
6. Describe seasonal changes in the length of the day and night and in the angle of the Sun above the horizon.
7. Recognize that the Moon's phases are regular and predictable, and describe the cycle of its phases.
8. Illustrate the phases of the Moon in drawings and by using improvised models. An improvised model might involve such things as a table lamp and a sponge ball.
9. Recognize that the other eight known planets, which revolve around the Sun, have characteristics and surface conditions that are different from Earth; and identify examples of those differences.
10. Recognize that not only Earth, but other planets, have moons; and identify examples of similarities and differences in the characteristics of those moons.
11. Identify technologies and procedures by which knowledge, about planets and other objects in the night sky, has been gathered.
12. Understand that Earth, the Sun and the Moon are part of a solar system that occupies only a tiny part of the known universe.

## Topic D: Evidence and Investigation

### Overview

Students sharpen their skills in observing and interpreting what they see by investigating evidence of human and animal activity. They explore and analyze indoor and outdoor environments as they look for footprints, markings, evidence of disturbance and things that are left behind. Through these studies, students learn to pose questions, devise investigations, recognize patterns and discrepancies, and think logically about what they have observed.

### General Learner Expectations

*Students will:*

- 6–8 Apply observation and inference skills to recognize and interpret patterns and to distinguish a specific pattern from a group of similar patterns.**
- 6–9 Apply knowledge of the properties and interactions of materials to the investigation and identification of a material sample.**

### Specific Learner Expectations

*Students will:*

1. Recognize evidence of recent human activity, and recognize evidence of animal activity in a natural outdoor setting.
2. Observe a set of footprints, and infer the direction and speed of travel.
3. Recognize that evidence found at the scene of an activity may have unique characteristics that allow an investigator to make inferences about the participants and the nature of the activity, and give examples of how specific evidence may be used.
4. Investigate evidence and link it to a possible source; e.g., by:
  - classifying footprints, tire prints and soil samples from a variety of locations
  - analyzing the ink from different pens, using paper chromatography
  - analyzing handwriting samples to identify the handwriting of a specific person

- comparing samples of fabric
- classifying fingerprints collected from a variety of surfaces.

## Topic E: Trees and Forests

### Overview

Students learn about trees as individual plants and as part of a forest ecosystem. By examining local species, they learn to recognize the characteristics of different trees and develop skill in describing and interpreting the structural features of trees. As part of their studies, students learn about a broad range of living things found on, under and around trees and study the complex interaction between trees and the larger environment. In examining human use of forests, they become aware of a broad range of environmental issues and develop an awareness of the need for responsible use.

### General Learner Expectations

*Students will:*

- 6–10 Describe characteristics of trees and the interaction of trees with other living things in the local environment.**

### Specific Learner Expectations

*Students will:*

1. Identify reasons why trees and forests are valued. Students meeting this expectation should be aware that forests serve as habitat for a variety of living things and are important to human needs for recreation, for raw materials and for a life-supporting environment.
2. Describe kinds of plants and animals found living on, under and among trees; and identify how trees affect and are affected by those living things.
3. Describe the role of trees in nutrient cycles and in the production of oxygen.
4. Identify general characteristics that distinguish trees from other plants, and characteristics that distinguish deciduous from coniferous trees.

5. Identify characteristics of at least four trees found in the local environment. Students should be familiar with at least two deciduous trees and two coniferous trees. Examples should include native species, such as spruce, birch, poplar, and pine and cultivated species, such as elm and crab apple.
6. Describe and classify leaf shapes, leaf arrangements, branching patterns and the overall form of a tree.
7. Interpret the growth pattern of a young tree, distinguishing this year's growth from that of the previous year and from the year before that. Students meeting this expectation should recognize differences in colouration and texture of new growth and old growth, and locate scars that separate old and new growth.
8. Identify human uses of forests, and compare modern and historical patterns of use.
9. Identify human actions that enhance or threaten the existence of forests.
10. Identify an issue regarding forest use, identify different perspectives on that issue, and identify actions that might be taken.